

Electronic Supplementary Information for

Synthesizing MnO₂ Nanosheets by Graphene Oxide Template for High Performance Pseudosupercapacitors

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1. Synthesis of the materials and the characterization method

Graphene oxide was prepared using modified Hummers method from flake graphite (average particle diameter of 20 μm, 99.95% purity, Qingdao Tianhe Graphite Co. Ltd., China). Briefly, 2.0 g of graphite and 1.5 g of NaNO₃ (A.R.) were placed in a flask. Then, 150 mL of H₂SO₄ (A.R.) was added with stirring in an ice-water bath, and 9.0 g of KMnO₄ (A.R.) was slowly added over about 1 h. The stirring was continued for 2 h in ice-water bath and continually stirred for 5 d at room temperature. Then 280 mL of 5 wt % H₂SO₄ was added over about 1 h with stirring, and the temperature was kept at 98 °C. The resultant mixture was further stirred for 2 h at 98 °C. After the temperature was reduced to 60 °C, 6 mL of H₂O₂ (30 wt %) was added, and the mixture was stirred for 2 h at room temperature. After centrifugation at 8000 rpm, the solid was redispersed using vigorous stirring and bath ultrasonication for 30 min at the power of 140 W. The centrifugation and ultrasonication were recycled for several times, and then the sample was rinsed with deionized water until the solution was neutral. Thus the graphene oxides were prepared. Then 5 mL of KMnO₄ solution (16 g/L) was added into 100 mL above graphene oxide suspension (about 0.1 g/L), and the mixture suspension was kept in thermostatwaterbath at 60 °C

for 15 h. The resulted materials were rinsed with deionized water and the layered MnO₂ nanosheets were obtained.

TEM, SAED and EDS analysis were performed on a JEM-2010. SEM image was obtained with a XL-30 ESEM. AFM image was obtained in air using a Digital Instrumental Nanoscope III in tapping mode. UV-vis spectra were measured using a UV-2550 spectrophotometer. XRD patterns were carried out using a MXPAHF with Cu K α source ($\lambda=1.541 \text{ \AA}$). Raman spectra were recorded using a LabRamHR. The laser excitation was provided by a regular model laser operating at 514.5 nm. XPS was analyzed by an ESCALAB 250.

The N₂-BET surface area was obtained with a DIL-402C surface area analyzer using N₂. The samples were degassed overnight at 300 °C. FT-IR was analyzed on a Nicolet 8700. TG and DTA curves were measured by using a Shimadzu TGA-50 thermogravimetric analyzer from room temperature to 800 °C with heating rate of 10 °C/min and an air flow rate of 50 mL/min.

2. EDS of manganese oxide nanosheets

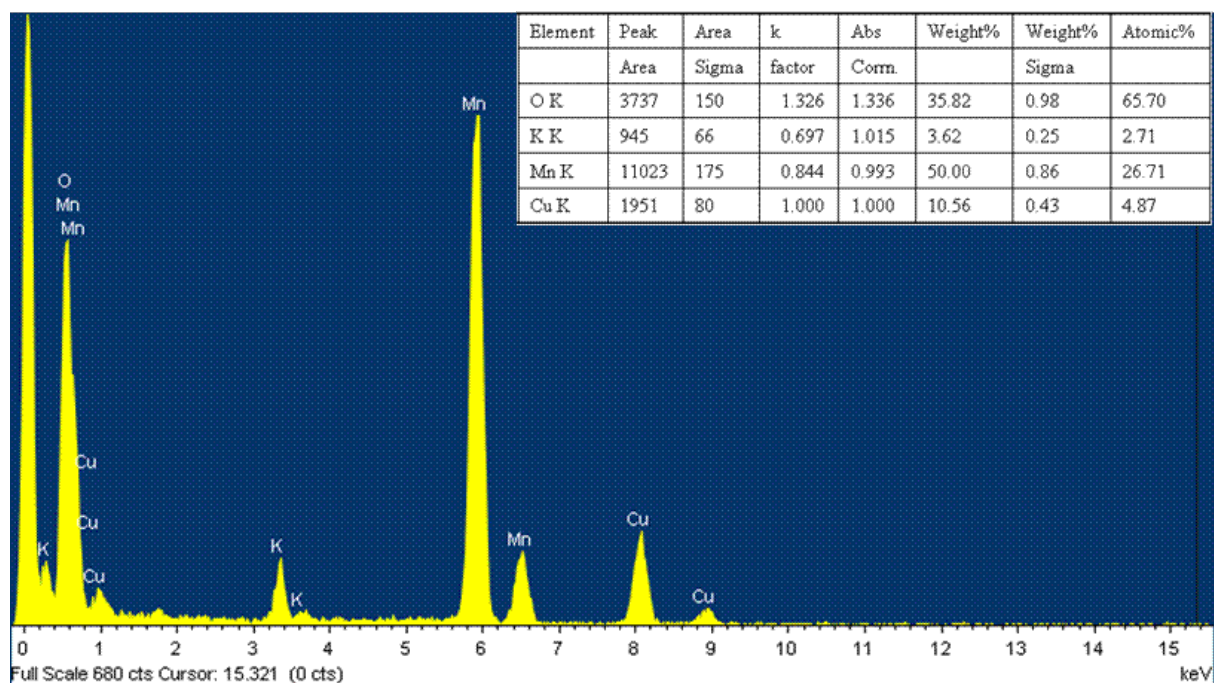


Figure S1. EDS of MnO_2 nanosheets on copper grid and the contents of the corresponding elements

3. FT-IR spectrum of manganese oxide nanosheets

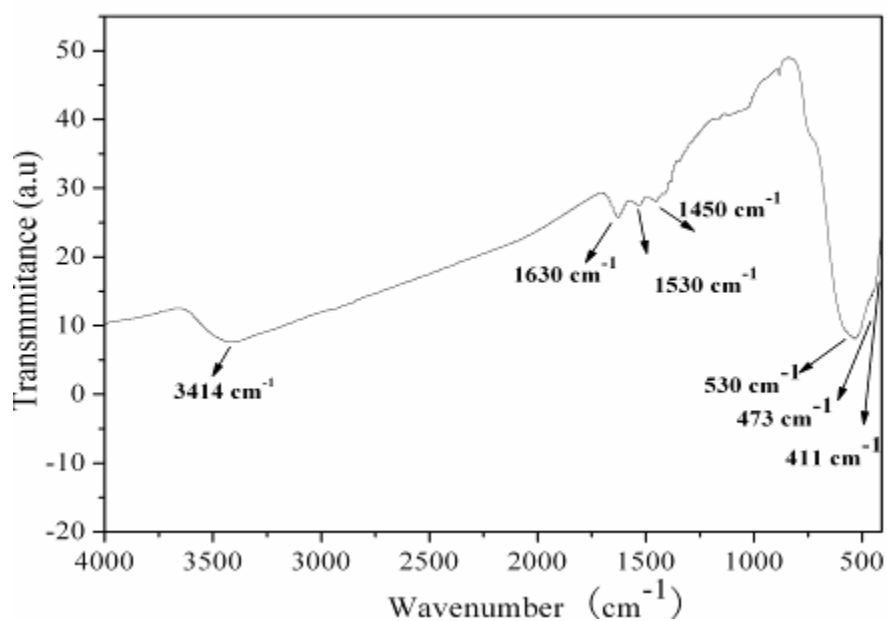


Figure S2. FT-IR spectrum of MnO_2 nanosheets

4. The thermogravimetric analysis of MnO₂ nanosheets

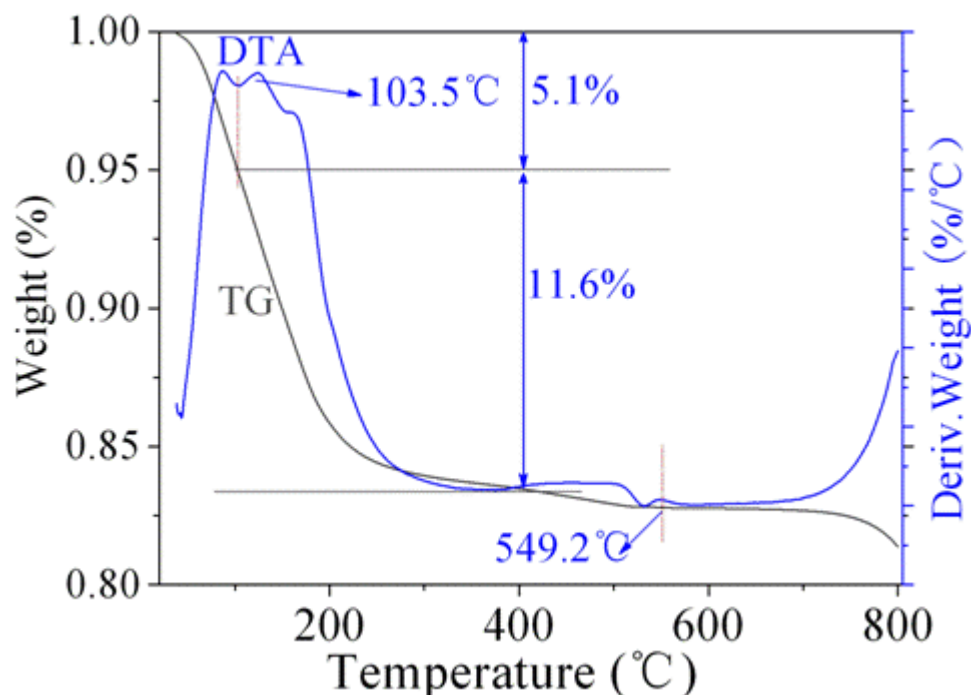


Figure S3. The TG and DTA curves of MnO₂ nanosheets

5. Electrochemical measurement

In the electrochemical measurement, the MnO₂ nanosheets were used as active material, mixed with polytetrafluorene-ethylene (PTFE) binder (5 wt%) and carbon black (10 wt%), added into a small amount of ethanol and daubed onto the Ni foam (1cm×1cm) to make the working electrodes, which was dried at 85 °C for 4 hours and compressed prior to the electrochemical test. Platinum wire (0.1 mm in diameter) and AgCl/Ag electrode (saturated with KCl) were adopted as the counter electrode and the reference electrode. Saturated K₂SO₄ solution was employed as electrolyte. All the electrochemical measurements (cyclic voltammetry and galvanostatic charge-discharge cycling curves) were carried out with a conventional three-electrode

cell using a potentiostat/galvanostat (WonA Tech). The control electrochemical measurement was carried out in the same process except without the loaded MnO₂ nanosheets. The resulted background signal is shown in Fig. S4.

6. The specific capacitance calculation by the electrochemical measurement

The specific capacitance values were calculated from the CV curves and the galvanostatic charge and discharge curves. For the CV curves, the following equation

was used: $C = \frac{\int Idt}{m\Delta V}$, where I is the oxidation or reduction current, dt is time

differential, m indicates the mass of the active electrode material, and ΔV indicates the voltage of one sweep segment. For the galvanostatic charge and discharge curves,

the calculation equation is: $C = \frac{I\Delta t}{m\Delta V}$, where I is the charge or discharge current, Δt

is the time for a full charge or discharge, m indicates the mass of the active electrode material, and ΔV is the voltage change after a full charge or discharge.

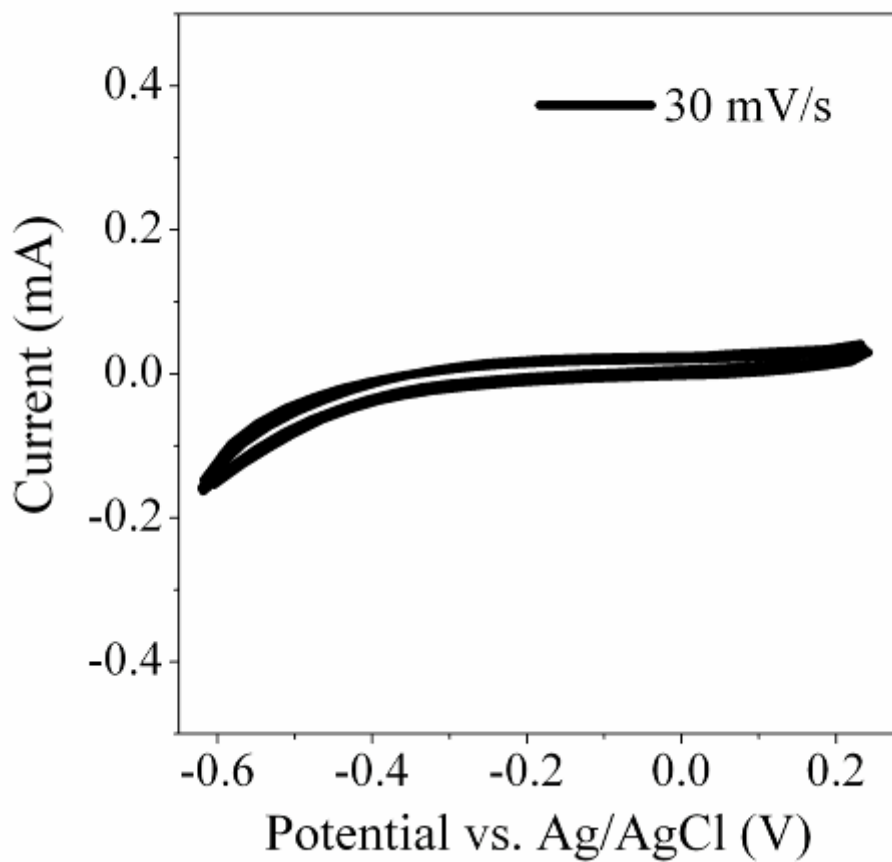


Figure S4. CV curves of Ni foam without loading MnO₂ nanosheets at a scan rate of 30 mV/s